



Colorado Department
of Public Health
and Environment

This update will tell you about:

- ✓ Site Background
- ✓ Sitewide Remedy
- ✓ Responsible Parties at the Lowry Site
- ✓ Progress of the Sitewide Remedy
- ✓ Ongoing Activities and Recent Changes
- ✓ 1,4-Dioxane Issues
- ✓ Second Five-Year Review
- ✓ Community Involvement

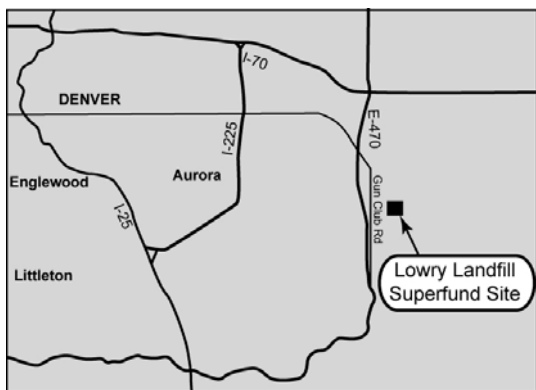


FIGURE 1. Site Location

Remedial Activities Continue and Second Five-Year Review Begins

EPA Region 8

July 2006

Lowry Landfill Superfund Site Information Update No. 17

Site Background

The approximately 480-acre Lowry Landfill Superfund Site (Lowry Site, or the Site) is located near the intersection of Quincy Avenue and Gun Club Road in Arapahoe County, 15 miles southeast of the City and County of Denver and 2 miles east of Aurora, Colorado (Figure 1). The Denver Arapahoe Disposal Site, an operating municipal solid waste landfill northeast of the intersection of Gun Club Road and East Hampden Avenue, forms the northern boundary of the Site. The City and County of Denver (Denver) owns both the Site and the Denver Arapahoe Disposal Site.

From the mid-1960s until 1980, Denver operated a “co-disposal” landfill at the Lowry Site, which means that both industrial waste (solid and liquid) and municipal solid waste were accepted for disposal. The liquids were placed into 78 unlined trenches over approximately 200 acres, and then solids such as soil, old tires, and household refuse were added to the trenches to absorb the liquids. The types of waste disposed at the Lowry Site using this practice included industrial degreasers, paint, pesticides, hospital and veterinary waste, metal-plating waste, petroleum products, sewage sludge, tires, and household waste.

The United States Environmental Protection Agency (EPA) estimates that approximately 138 million gallons of industrial wastes were disposed of at the Lowry Site. Nearly all of these wastes were disposed in the southern half of the Site within the 200-acre main landfill. A much smaller volume of waste was placed north of the main landfill in ponds and waste pits. Some liquids were sprayed directly onto the soil in large “leachate spraying” areas located in the northern part of the Lowry Site.

During the 1970s and 1980s, millions of tires accumulated at the Site. The tires were laid on top of other waste that had been placed in three separate pits, each approximately 20-30 feet deep. From 1989 through 1992, Denver and its contractors removed, shredded, and consolidated the tires and placed the tire shreds in a monofill on the east side of the Lowry Site for potential future re-use as



fuel. The area and three waste pits that lay under the tires became known as the Former Tire Pile Area (FTPA).

In 1980, Denver stopped co-disposal practices. Landfill operations continued at the Lowry Site until 1990, but were restricted to disposal of municipal solid waste only. From 1980-1990, Waste Management of Colorado (WMC) operated the Lowry Landfill under a contract with Denver.

The waste disposed at the Lowry Site contaminated the soils and, eventually, shallow groundwater. Additionally, gases from the buried wastes contaminated the air spaces in subsurface soil.

In the mid-1970s, EPA, the Colorado Department of Public Health and Environment (CDPHE), Denver, and other parties began investigating the soil, groundwater, surface water, sediment, air quality, and soil gas at the Lowry Site in response to complaints from nearby residents about odor, disposal practices, and potential fire danger. In 1984, EPA designated Lowry Landfill as a Superfund Site. This designation allowed EPA to access federal funding from the Superfund trust fund to conduct investigations into the environmental problems there. The Superfund designation also allowed EPA to compel those responsible for disposal of hazardous substances to perform investigations or otherwise contribute to the effort.

In 1990, all landfill operations at the Lowry Site stopped to allow environmental investigations to proceed without interference. The landfill operator, WMC, constructed a soil cover over the 200-acre main landfill in the southern part of the Site. The landfill cover is at least 4 feet thick and up to 12 feet in thickness in some places.

Site Investigations and Actions

After investigating the contamination at the Site, evaluating the potential risk the Site posed to human health and the environment, and considering alternative strategies for cleaning up the Site, EPA selected a comprehensive plan for the Lowry Site in 1994. The plan is described in detail in the Record of Decision (ROD) signed by both EPA and CDPHE on March 10, 1994.

The plan is based on the concept of “containment,” which means protective measures are put in place to prevent movement of contamination off site above safe levels. The overall goal of containment is to prevent human exposure to landfill gas, waste pit liquids, and unsafe levels of contamination in soil, surface water, and groundwater. EPA requires proof that safe levels are achieved at locations inside the Site boundaries, called the point of compliance (POC), illustrated on Figure 2. Most of the components of the plan are currently in place and operating to achieve the objectives described in the 1994 ROD. The completed components are described below and shown on Figure 2.

Changes to the 1994 ROD

EPA issued several changes to the ROD based on new information obtained during design and implementation of the remedy.

A minor modification to the ROD on August 7, 1995, clarified the institutional controls and allowed ongoing permitted waste disposal to continue.

The first Explanation of Significant Differences (ESD) on August 14, 1995, made minor corrections to the performance standards for groundwater, air quality, and landfill gas and also modified the groundwater point of action boundary.

The second minor modification to the ROD on March 21, 1996, clarified the requirements for mitigation of wetlands.

The second ESD on October 24, 1997, modified the remedy to allow treated water from the water treatment plan to be discharged to an offsite publicly owned wastewater treatment facility. The second ESD also modified the remedy for the FTPA waste pits to allow onsite treatment and disposal of material excavated from the FTPA waste pits.

The third minor modification to the ROD on May 8, 2001, changed the air quality performance standard for one compound.

The fourth minor modification to the ROD on September 30, 2002, changed the performance standards for groundwater, air quality, surface water, and landfill gas.

A ROD Amendment in August 2005 changed the remedy for the north and south FTPA waste pits (refer to page 7 for more information).



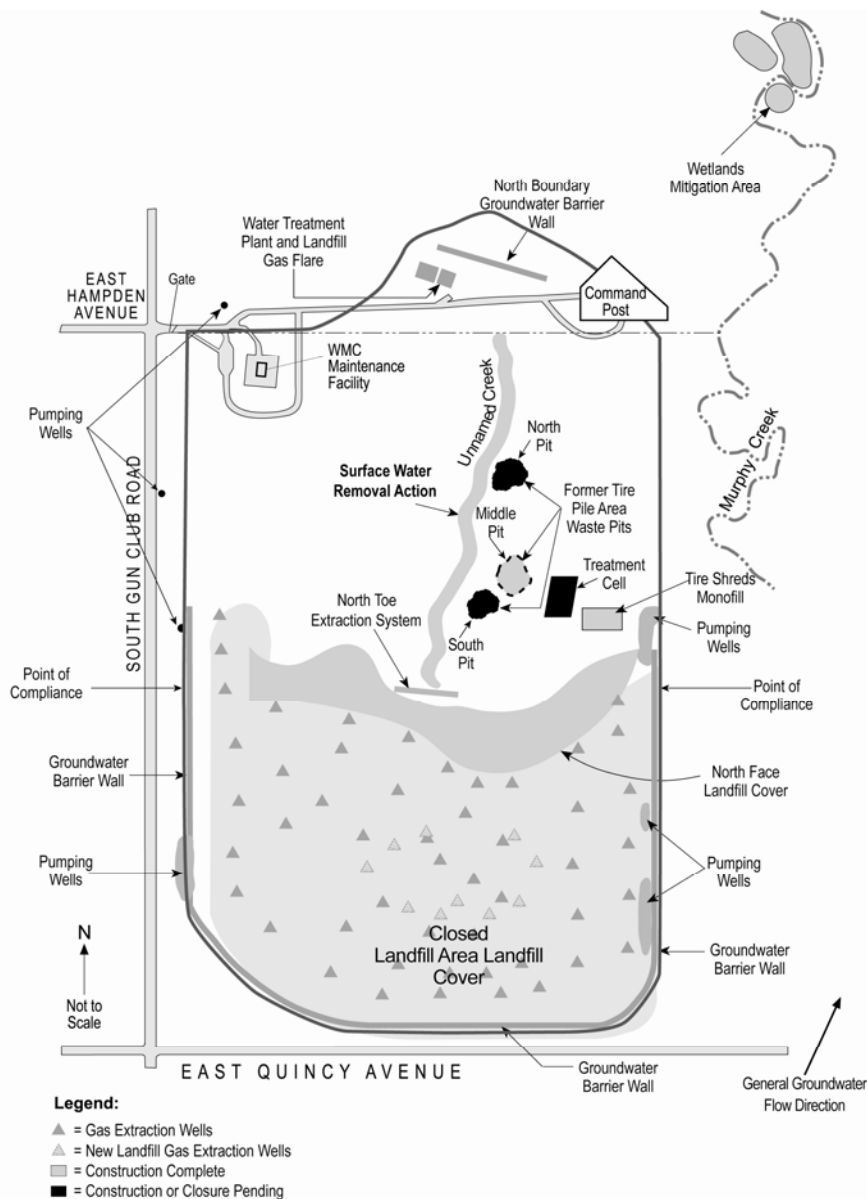


FIGURE 2. Sitewide Remedy Map

An 8,800-foot-long underground Groundwater Barrier Wall of soil and clay encloses the west, south, and east sides of the main landfill in the southern part of the Site. The wall is below the ground surface, approximately 40 to 75 feet deep. The wall minimizes the flow of clean groundwater onto the Site from the south and west, and the flow of groundwater away from the Site to the east, reducing the volume of contaminated groundwater produced by contact with the wastes buried in the landfill.

The existing landfill cover is maintained as part of the plan selected in the ROD. The cover minimizes the amount of rainwater that can seep into the landfill, thereby reducing the amount of groundwater that could become contaminated by contact with the wastes in the landfill. In 1999, 2 feet of additional soil cover were placed on the 29-acre north face of the landfill to provide a minimum cover thickness of 4 feet over the entire closed landfill area.

At the northern limit of the main landfill, a trench (North Toe Extraction System) collects

contaminated groundwater flowing north from the buried wastes. The groundwater collected in the trench is pumped to the water treatment plant located at the northern boundary of the Site.

At the intersection of the Unnamed Creek alluvial channel and the northern Site boundary, the North Boundary Barrier Wall (NBBW) captures contaminated groundwater. This 1,000-foot-long and 30-foot-deep clay wall provides a barrier to groundwater flow to the north. At the upstream side of the NBBW, a gravel bed allows collection and removal of migrating groundwater. Groundwater from the gravel bed is pumped to the water treatment plant.

Denver originally built an onsite water treatment plant in 1984. The plant has undergone several upgrades, most recently in 2004. Contaminated water collected from various areas of the Site is treated at the plant to a level safe for discharge into a sanitary sewer line. The discharged water eventually reaches the Metro



Wastewater Reclamation District and the City of Aurora's wastewater treatment facilities located off site. The City of Aurora and the Metro Wastewater Reclamation District issued the industrial pretreatment discharge permit for the water treatment plant at the Site. The offsite facilities only accept water that complies with the terms of the Site industrial pre-treatment discharge permit.

North of the closed landfill area, contaminated groundwater is kept separate from clean surface water within the streambed of Unnamed Creek by a layer of permeable material that has been placed in the streambed and covered with clay. The permeable



Groundwater Sampling at the Lowry Site

material provides a pathway for groundwater to flow to the north without contacting surface water. The top of the clay cover is now the streambed, allowing clean surface water to run off the surrounding Site areas and migrate to the north without coming into contact with contaminated groundwater flowing underneath the cover.

A landfill gas collection system of 54 extraction wells was installed in the main landfill to remove and burn gases generated from the buried waste. In 2006, 10 new landfill gas extraction wells were added to the system to collect gas from deeper within the landfill mass. Landfill gas extracted from all 64 wells is routed to an enclosed flare at the northern end of the Site where it is burned. Emissions from the flare are monitored to ensure that they meet environmental standards and are safe for the surrounding community.

As an extra measure of protection from exposure to the wastes remaining at the Site, Denver, Arapahoe County, and the City of Aurora enacted land and groundwater usage controls. These controls work to prevent people from coming into contact with the contaminated soil, water, or landfill gas that remains on the Site. In addition to Denver, both EPA and CDPHE have the authority to enforce the onsite controls.

Long-term monitoring programs are in place to evaluate the effectiveness of the containment and collection systems, and the overall protectiveness of the cleanup actions.

EPA identified more than 50 chemicals of concern at the Site including volatile organic compounds, polynuclear aromatic compounds, and metals. The contaminated shallow groundwater at the Site is not used as a drinking water source. Current health risks are limited because access to the Site is restricted. Offsite groundwater used as drinking water is not believed to be contaminated by the wastes from the Lowry Site.



Responsible Parties at the Lowry Site

The Superfund law mandates that EPA require past and present site owners and operators as well as parties who generated or transported hazardous substances to Superfund sites to pay for studies and perform the work at those sites. These parties are known as Potentially Responsible Parties, or PRPs.

EPA identified more than 200 PRPs for the Lowry Landfill Superfund Site. In November 1994, EPA ordered 34 of the major PRPs (the owners and operators of the Site, the Site's largest-volume waste generators, and transporters to the Site) to perform the work to design, construct, and operate the sitewide remedy. Three of these PRPs, Denver, WMC, and Chemical Waste Management of Colorado, Inc. (CWM), reached agreements with the other PRPs to perform the Site work on behalf of themselves and the other PRPs. Denver, WMC, and CWM are responsible for designing, constructing, and operating the sitewide remedy under EPA and CDPHE oversight.



Monitoring Well Installation

In August 2005, the United States reached a settlement with Denver, WMC, CWM, and five other PRPs after nearly 3 years of litigation. Under the settlement, the settling defendants agreed to pay \$13.9 million to reimburse the United States' past response costs and to perform and finance the remainder of known work at the Site. Notice of the proposed settlement was published in the *Federal Register* on August 26, 2005. After a 30-day public comment period, the federal district court entered the Consent Decree embodying the settlement. Denver, WMC, and CWM (the Work Settling Defendants) are performing and financing the remainder of known work at the Site on behalf of themselves and the other settling defendants.

Progress of the Sitewide Remedy

As of 2006, all components of the sitewide remedy have been constructed and accepted by EPA except the components for the FTPA waste pits (see Figures 2 and 3). Denver, WMC, and CWM are operating, maintaining, and monitoring the constructed remedy components under oversight by EPA and CDPHE. Figures 2 and 3 show the sitewide remedy components and the status of the remedial actions. Figure 4 depicts the construction status of remedy components.



FIGURE 3. Sitewide Remedy Components and Status

Remedy Component	Description	Status
Institutional Controls	Institutional Controls Plan listing regulations, laws, and covenants that govern land use, water use, zoning, and access.	EPA approved the plan on September 26, 2002.
Surface Water Removal Action (SWRA)	Drain with clay cover, and treatment of groundwater in onsite water treatment plant (WTP).	EPA certified completion on August 11, 2005.
Wetlands Mitigation	Constructed wetlands to replace those lost during construction of the SWRA.	EPA certified completion on August 12, 2005.
Landfill Gas (LFG) Extraction and Treatment System	LFG collection and treatment system.	EPA certified completion on February 11, 1998.
North Boundary Barrier Wall (NBBW) System	Subsurface barrier wall at northern Site boundary; groundwater collection drain upgradient of wall, and injection trench downgradient of wall.	EPA certified completion March 27, 1998.
North Toe Extraction System (NTES)	Shallow groundwater collection trench at northern toe of landfill mass.	EPA certified completion on September 10, 1998.
East/South/West Groundwater Barrier Wall	Soil-bentonite slurry wall surrounding east, west, and south sides of landfill to restrict contaminated water from flowing off site.	EPA certified completion on September 30, 1998 (slurry wall), and January 25, 1999 (monitoring system).
Well 38 Area Gradient Control Contingency Measure	Groundwater extraction via wells from the MW38 sand channel.	EPA certified completion on August 11, 2005.
New Water Treatment Plant	Upgraded WTP to pre-treat Site waters on site, followed by discharge to and final treatment in Publicly Owned Treatment Works (POTW).	EPA certified completion on August 11, 2005.
FTPA Middle Waste Pit	Excavation of the FTPA Middle Waste Pit and construction of the onsite treatment cell.	EPA certified completion of the Middle Waste Pit on August 3, 2005. Closure of the treatment cell is ongoing.
North Face Cover	Placement of additional clay cover over 29 acres on the North Face of landfill.	EPA certified completion on January 7, 2000.
Well Abandonment Program	Removal of wells that were constructed improperly or no longer serve a useful purpose.	EPA certified completion on November 17, 1997.
Performance and Compliance Monitoring	Development and implementation of a long-term monitoring plan to assess compliance with performance standards for all remedy components.	EPA certified construction completion of the wells on August 12, 2005. Long-term monitoring program is ongoing.



Former Tire Pile Area Remedy

The FTPA comprises about 54 acres north of the main landfill area and east of Unnamed Creek (see Figure 2). Initial investigations found three separate waste pits at this location. These pits are separate from the main closed landfill in the southern portion of the Site, although they contain similar wastes. The 1994 ROD called for digging into the FTPA waste pits to remove surface and subsurface drums, free liquids, and other visual contamination. Contaminated materials were to be disposed of off site. In 1997, EPA changed that plan to allow the contaminated materials to be treated using controlled aeration and disposed of on site. Denver, WMC, and CWM (and their contractors) successfully completed excavation of the middle waste pit in 1998.

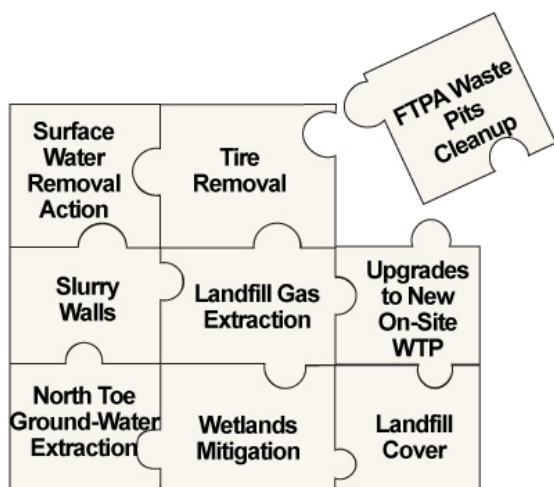


FIGURE 4. Construction Status of Remedy Components

In May 1999, while excavating the north waste pit, those parties' contractors encountered more highly contaminated waste liquids and vapors than had been anticipated. Some contaminated vapors were expected and precautions had been taken such as digging within an enclosed structure and ventilating and treating vapors from the structure. However, the amount and toxicity of vapors produced were not expected, overwhelmed the safety measures in place, and became dangerous to the workers. As a result, EPA granted permission for the digging to stop. Subsequently, EPA required additional investigations and studies in the FTPA waste pits.

After reviewing the results of these studies, EPA proposed a fundamental change in the selected remedy for the remaining two FTPA waste pits. The new remedy was described in a Proposed Plan for the FTPA, issued to the general public by EPA in May 2005. EPA held two public meetings in June 2005 to hear the public's comments on the proposed change.

After reviewing public, State, and local government comments on the Proposed Plan, EPA issued a ROD Amendment on August 12, 2005, selecting Capping with Product Recovery as the remedial action for the north and south FTPA waste pits. This was the alternative that EPA proposed in the May 2005 Proposed Plan. Capping with Product Recovery includes pumping the most highly contaminated liquids from the north and south waste pits, transporting these liquids off site for disposal, maintaining a cap on the waste pits, and monitoring groundwater migrating from the waste pits.

The contaminated soils removed from the FTPA middle waste pit in 1999 were consolidated in a lined and covered cell where they were treated using controlled aeration to remove the volatile contaminants. Treatment continued until 2003 when the treatment goals were achieved.

As part of the remaining work at the FTPA, Denver, WMC, and CWM will remove the cover from the treatment cell and move the treated soils to a new, permanent location within the main landfill



What is a CAMU?

A Corrective Action Management Unit, or CAMU, is a designated area on a site that is undergoing remediation where hazardous waste from remediation activities is treated, stored, or disposed. The CAMU concept was created by EPA regulations to encourage treatment at remediation sites. The CAMU concept provides EPA and authorized states the flexibility to develop site-specific design, operating, closure, and post-closure requirements for CAMUs in lieu of design requirements for land-based units specified in the Resource Conservation and Recovery Act (RCRA).

EPA has a strong preference for using CAMUs to facilitate treatment at remediation sites. Remediation waste placed in a CAMU does not have to meet treatment standards for land-disposed waste specified in RCRA. When a CAMU is used, remediation waste may be treated and then placed in a CAMU. CAMUs may be located in uncontaminated areas at a site, and wastes may be consolidated into CAMUs from areas that are not contiguously contaminated.

mass. The benefits of moving the treated soils to this new location are that they will be underneath the landfill cap and surrounded by the underground Groundwater Barrier Wall and groundwater monitoring system.

Although the soils were treated to remove volatile contaminants, there are other contaminants in the soils that were not removed by the treatment process. State and EPA regulations require that soils exhibiting characteristics of hazardous waste meet specific standards if they are disposed on the land. The treated soils do not meet these standards for a few contaminants. If the soils are being managed as part of a Superfund cleanup action, regulations allow them to be disposed of on site within a specially designed and designated management unit without meeting the standards. The management unit is called a "Corrective Action Management Unit," or "CAMU." As part of the remaining work at the FTPA waste pits, a CAMU will be constructed within the main landfill mass and the treated soils will be permanently disposed of in the CAMU.

All of the remaining work at the FTPA waste pits is expected to begin during the summer of 2006.

Groundwater Monitoring Plan

The ROD requires ongoing monitoring, including sampling of groundwater, surface water, landfill gas, sediments, and water treatment plant effluent, to provide information about how well the remedy components are working.

In February 2005, EPA approved an updated comprehensive Groundwater Monitoring Plan (GWMP) for the Site. This new GWMP incorporates many of the components of previous monitoring plans that had been in place at the Site. However, it also reflects the increased understanding derived during the Remedial Investigation, Remedial Design, and Remedial Action phases of work at the Site and from approximately 7 years of subsequent operation, monitoring, and maintenance of the various components of the Site's groundwater containment system.

During the more than 20 years that the Site has been investigated and its remedy implemented, hundreds of wells have been installed and used extensively to monitor the occurrence, movement of, and contaminant levels in the groundwater underlying the Site. In addition, hundreds of soil borings have been drilled into the Site to better understand the geology so that the remedy can be monitored to assure it is effective and protective. The information from the existing wells and soil borings was carefully considered in the selection of the wells that are designated for long-term monitoring in the GWMP.

The GWMP will be used to ensure that the groundwater containment remedy remains effective and protective, and in



compliance with water quality standards, in perpetuity. The GWMP was submitted by Denver, WMC, and CWM and approved by EPA with concurrence from CDPHE and the Tri-County Health Department on February 18, 2005. The groundwater monitoring program is a component of the overall remedy for the Site.

Compliance with groundwater performance standards is monitored vertically (with depth) as well as horizontally (near the property boundaries). The GWMP includes the following elements:

Compliance Monitoring – Groundwater quality monitoring along the downgradient boundaries of the POC (Figure 2) to assess compliance with groundwater performance standards to verify the protectiveness of the containment remedy;

Effectiveness Monitoring – Water level and/or water quality monitoring to assess the effectiveness of the four components of the containment remedy at the site (i.e. Perimeter Slurry Wall, North Toe Extraction System, North Boundary Barrier Wall, and MW38 Channel); and

Vertical Monitoring – Groundwater quality monitoring to provide early detection of possible future vertical migration, if any, of contamination immediately downgradient of the main landfill mass and the FTPA waste pits.

The GWMP also describes the specific responses that Denver, WMC, and CWM will undertake if groundwater does not meet Site performance standards at a given well.

Landfill Cover Operation and Maintenance

The ROD requires maintenance of the existing cover on the main landfill mass. The landfill cover is an important component of the containment remedy because it minimizes the amount of rainwater that can seep into the landfill mass, thereby reducing the amount of groundwater that could become contaminated by contact with the wastes in the landfill. A large landfill cover maintenance project will begin in 2006. The project involves regrading the landfill cover to increase its slope and promote drainage of surface water runoff away from the landfill mass. The regrading project will reduce the future maintenance activities for the cover.

Denver, WMC, and CWM proposed to regrade the landfill cap by additional landfilling of construction and demolition debris on the Section 6 landfill. The landfilling operation will fill underground air space, promote positive drainage, and increase the slope of the landfill cover. The slope will be increased by removing and stockpiling 2 feet of the cover and placing an additional 5.6 million cubic yards of construction and demolition debris on top of the landfill. The cover will then be replaced and reconstructed. No municipal solid waste disposal will be allowed



Well 38 Source Area Control Investigation



and only limited industrial waste will be approved for disposal. Construction materials may include masonry, concrete, brick, and rock. The regrading project is expected to continue for 7-14 years.

North End Investigation

As part of the ongoing groundwater monitoring program, the chemicals 1,4-dioxane and nitrate were detected in 2005 at levels above performance standards in three shallow groundwater wells.

The GWMP requires that whenever standards for groundwater are not met in compliance wells and there is a potential for the contamination to migrate off site, Denver, WMC, and CWM must evaluate the extent of the problem. In 2005, Denver, WMC, and CWM installed 42 temporary wells, 13 permanent wells, and 76 soil gas survey points in the north end of the Site to evaluate the extent of the problem.

In January 2006, EPA approved a work plan for a more extensive investigation. The North End Investigation of groundwater is continuing. The objective of the North End Investigation is to determine the extent of the groundwater and surface water impacts in this area. Additional information on the 1,4-dioxane detections and the investigations are provided in the insert to this update.



North End Investigation Well Installation

Second Five-Year Review for the Lowry Landfill

The Superfund law requires EPA to review the cleanup actions at Superfund sites where contamination has been left in place. These reviews are required to be conducted at least every 5 years. The purpose of the “Five-Year Review” is to determine if the actions are protective of human health and the environment.

EPA completed the first Five-Year Review for the Site in September 2001. EPA started work on the second Five-Year Review for the Lowry Site in March 2006, and will complete the review by September 30, 2006.

EPA, the lead regulatory agency at the Lowry Site, is responsible for conducting the Five-Year Reviews. CDPHE, the support regulatory agency, will also participate in the review. As part of its conduct of the second review, EPA will review Site documents and data, conduct a Site inspection, and gather input from other regulatory agencies, local government officials, and the general public.

EPA will prepare a report summarizing the review’s findings and will notify the public of the availability of the report. You will be able to review the report at the Site information centers listed on page 12 of this update. EPA will also report the results of the second Five-Year Review to Congress.

EPA uses three key questions to determine whether the remedy is protective of human health and the environment:

1. Is the remedy functioning as intended by the Record of Decision or ROD, the document that presents the remedy to be used at a Superfund site?
2. Are the assumptions used at the time of remedy selection still valid?
3. Has any new information come to light that could affect the protectiveness of the remedy?



Community Involvement

Community involvement is an important part of the remedial process to keep the public informed about the Lowry Site and to provide opportunities to participate in the Superfund process. EPA and CDPHE welcome your participation.

The Lowry community involvement program includes meetings, fact sheets, a Web site, and opportunities to comment on key documents.

Technical Assistance Grants

EPA awards Technical Assistance Grants (TAG) to local community groups to hire technical advisors to review Site activities such as studies, designs, and construction. At the Lowry Site, EPA awarded a TAG to the Citizens for Lowry Landfill Environmental Action Now (CLLEAN), a group of local area residents. Members of CLLEAN and its consultants attend technical meetings and review Site activities on behalf of area homeowners' associations.

For information about CLLEAN, please contact Bonnie Rader at (303) 912-2905.

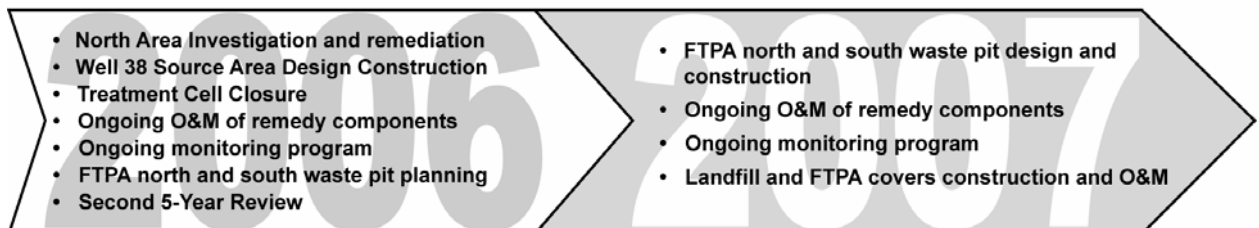
Site Tours

EPA would be happy to help arrange a site tour or meeting for interested school, community, or local homeowners' association groups to provide more information about the Lowry Site. For information, please contact Nancy Mueller at (303) 312-6602.

Update to the Community Involvement Plan

EPA is preparing an update to the Site Community Involvement Plan. The update will identify community issues and concerns, and recommend specific community involvement activities. EPA will conduct interviews and update the official contact lists, public meeting locations, and local media contacts. EPA will complete the update in September 2006 in conjunction with the second Five-Year Review.

Schedule of Future Activities



Where to Find More Information on the Lowry Site

EPA Superfund Records Center
(Complete Site Files and Administrative Record)
999 18th Street
Denver, CO 80202
(303) 312-6473



Aurora Public Library
(Selected Documents)
14949 East Alameda Drive
Aurora, CO 80012
(303) 739-6600

Additional information about the Lowry Site can also be obtained on the Internet at:

<http://www.epa.gov/region8/superfund/sites/co/lowry.html>

Key Contacts

If you have questions about the Five-Year Review at the Lowry Site or would like to be added to (or removed from) the mailing list, please contact any of the following individuals:

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